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Cell Phone Distraction Analysis Of Motor Response In A Simulated Driving Environment

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CELL PHONE DISTRACTION
ANALYSIS OF MOTOR RESPONSE IN A SIMULATED DRIVING ENVIRONMENT

By

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ABSTRACT

Does the use of a cell phone while driving influence the driver's ability to execute a proper turn? Is there difference between genders pertaining to motor skill while driving in a simulated driving environment? To accomplish this task, three groups of ten participants (5 women and 5 men) each were tested using a scripted test scenario focusing on left and right turns. The participants were made to drive through a test scenario to get used to the driving simulator. The scenario for the experimental group was an inner-city training scenario with the presence of vehicular traffic and the main focus area was on six critical turns (3 left and 3 rights). The apparatus used for this study was the "Patrol Simulator" built by GE Driver Development. A 2 (Gender) x 3 (Cell phone condition) between subjects design was used to assess the differences in mean driving performance between gender (male and female) at 3 cell phone conditions (No Phone, Phone No Conversation, Phone with Conversation). The study verified that cellular phones would adversely affects a driver's ability to perform turns, and showed that gender plays a role in this effect. However, it did confirm that gender does not play any role in a person's overall ability to drive. The results indicated a significant main effect for Cell phone Condition for overall turns, F (2, 24) = 38.83, $p > .0005$, $\eta^2 = .76$. Results also indicated a significant interaction between Gender and Cell Phone Condition, F (2, 24) = 3.97, $p = .032$, $\eta^2 = 0.25$.

ACKNOWLEDGMENTS

I would like to thank my advisor Dr. Peter Kincaid who supported me throughout the graduate program. I would also like to thank Ms. Telleah Allen who tolerated my continuous interruption in the simulation lab. A special thanks to all the folks at the Institute for Simulation and Training who supported me through the last year and a half.

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INTRODUCTION

The purpose of this research is to study the effect of using a cell phone while driving in a simulated driving environment and also analyze the possible effect of gender. Driving simulation can provide an insight into the effects of real world stimuli on a potential driver. Knowledge of the effects of stimuli caused when talking on a cellular phone while driving can help in giving a clear picture of how much distraction could be caused. Real world studies have already confirmed that cellular phone use is a hindrance to drivers.

In today's world talking on a cell phone while driving is an extremely common occurrence. This results in considerable distraction and hence seems to be the cause of a number of accidents. Simulating this is a way to analyze the extent of impact of this distraction on a driver resulting in deteriorating concentration while driving. One can imagine that the worst impact of using a cell phone while driving might be on the proper execution of right and left turns. Simply stated, it is the author's assertion that talking on a cell phone while driving in a simulated driving environment reduces the driver's ability to execute a proper turn. Secondly, there is expected to be no difference between genders pertaining to motor skill required to execute turns while driving in a simulated driving environment. This study also validated the GE Patrol-SIM as an adequate substitute to real world testing.

To accomplish this task, a simulation scenario focusing on three different kinds of left and right turns was scripted. The participant was told to drive on an initial pre-scripted scenario to make sure that he/she gets accustomed to the functioning and mechanism of the Patrol Simulator. The actual test scenario was a suburban environment with the presence of vehicular traffic scripted using the Scenario Editor provided by GE. Does talking on a cell phone really affect the driver's ability to execute proper turns? Is there a difference between genders pertaining to motor skill while driving in a simulated driving environment? To answer these questions three groups of ten participants (5 women and 5 men each) were tested. The participants were scored on six critical turns: Stop Sign Turn, Signal Turn and a Continuous Turn (each correspondingly having 1 left and 1 right turn). A 2 (Gender) x 3 (Cell phone condition) between subjects design was used to assess the differences in mean driving performance between gender (male and female) at 3 cell phone conditions (Without cell phone, Cell phone without conversation, Cell phone with conversation).

The outcome of this study clearly suggests that use of cellular phones while driving would adversely affects a driver's ability to perform turns, and showed that gender does play a role in the effect. However, it did confirm that there were no main effects pertaining to gender on any turn or overall. The fact that gender was not an issue is in itself noteworthy. These results thereby validate simulation as capable of simulating the effects of cell phones on real world drivers.

BACKGROUND

Driver inattention due to cell phone use and its implications for the motoring public at large is now a source for concern. Cell phones have been available for years and according to the Cellular Telecommunications & Internet Association, there are 137 million subscribers in the United States alone. In addition, the National Highway Traffic Safety Administration estimates at any given time of day, 500,000 drivers are talking on cell phones (Goepel, 2003). This has resulted in speculation concerning automobile accidents and cell phone use. On February 1st, 2002 an accident on the Capital Beltway, outside of Washington, killed five people. An investigation showed that the driver, who on that day had purchased the SUV, had made or received over 15 calls on her mobile phone in the four hours prior to the fatal accident. The National Transportation Safety Board concluded the cell phone conversations contributed to the driver's loss of control of the vehicle (Zabarenko, 2003).

The equipment for the test was the "Patrol Simulator" built by GE Driver Development. According to Woong-Sung, Jung-Ha & Jun-Hee (2003), driving simulators are devices that immerse the operator in a realistic driving environment through feedback of visual, audio and tactile modalities. Likewise, Amico, Bruzzone & Guha (2001) suggest that possible accidents or large financial losses during the operation of complex man-machine systems can be devastating and in these circumstances simulation can prove to be invaluable. In addition, due to advances in computing technology simulation has become an efficient tool for investigation, design, research, training and logistics. Moreover, according to Pierowicz, Robin & Gawron (2001), simulators have been fruitfully engaged within the military arena and commercial airline business for over

30 years. If amply established, simulation technology may complement the training, testing, and licensing of commercial motor vehicle (CMV) drivers. Consequently, universities throughout the United States as well as the world have invested in driver simulators to carry out research and training.

The University of Central Florida is the home of four levels of driving simulators; the first is a desktop simulator (Figure 1) for basic training and scenario development. The second is the mid-level Vsim Simulator which is illustrated in Figure 6. The third is the Patrol Sim (Figure 2), which provides training for police and emergency personnel and finally the full motion simulator (Figure 3) by GE, which is housed in the College of Engineering.

SIMULATOR SICKNESS

Both simulators and Virtual Environments can cause different types of sickness or other physical problems. These can include visuomotor dysfunctions (eyestrain, blurred vision, difficulty in focusing), mental disorientation (difficulty in concentrating, confusion, apathy), and nausea including vomiting. Other symptoms may include drowsiness, fatigue, eyestrain, and headache. 20% to 40% of fighter pilots suffer from these symptoms when using simulators and the symptoms may last for several hours.

Causes for sickness

There are two necessities for simulator sickness: a functioning vestibular system (the set of canals, tubes, etc. in the inner ear that gives us a sense of orientation and acceleration) and a sense of motion. There is no definitive explanation for simulator motion sickness but one idea is that it arises from a mismatch between visual motion cues and physical ones, as perceived by the vestibular system. This can happen when there are no physical motion cues (no motion platform is used) or the physical and visual cues are not synchronized. In VE systems, simulator sickness occurs both in motion based systems, e.g. a game pod, and in physically static systems. One hypothesis as to why this occurs is these inconsistent perceptions are similar to what occurs when poison is ingested and we evolved to vomit and get rid of the poison.

UCF DRIVING SIMULATORS

Desk Top Simulator

The desktop simulator (Figure 1) consists of a standard 19 inch monitor and utilizes Windows 2000 platform. The steering, fuel pedal and gas pedal are a WingMan Formula GP by Logitech. The computer is a Pentium 4 using G force 3 and Direct X to generate the graphics. This simulator is used as a development station for scripting scenarios, which can be loaded to the Patrol Sim, Mid-level Simulator, or the full motion simulator. Also, the desktop can be used as a training tool for enhancing situational awareness for student drivers. While the patrol sim as well as the full motion sim are discussed in this section of the paper, the mid-level simulator is addressed in the materials section.

Figure 1: Desktop Simulator

Mid-level V sim Simulator

The TranSim VS™ truck-driving simulator (Figure 2) is a mid-range truck-driving simulator with a six by six-foot print developed by GE. In basic mode, it can accurately simulate the behavior of approximately 240 engines, 140 transmissions, 33 axle ratios, and 300 tire sizes, along with road conditions and various grades. Trainees and drivers learn the proper way to shift a variety of transmissions over different grades, pulling an assortment of loads—all from the safety and convenience of the classroom (General Electric).

Figure 2: Mid-Level Simulator from GE

Patrol Simulator

“The Patrol Sim simulator (Figure 3) offers law enforcement agencies a high fidelity, interactive training experience that helps save lives. The three channel immersive driving environments combine the look and feel of a real squad car with the most advanced technology on the market” (GE Driver Development, 2003). The Patrol Sim is proving to be a valuable training tool with limitless research possibilities.

Figure 3: Patrol Simulator

Full Motion Simulator

"The Mark II Motion-Based Driver Training Simulator (Figure 4) combines a fully operational truck cab with the latest digital simulation technology to create life-like training scenarios that improve driving behavior and skill" (GE Driver Development, 2003). Some of the research areas include driver training, human factors and traffic engineering. Recent research projects include evaluation of a prototype (Safety Warning System) to enhance driver safety while the second project focuses on minimum acceptable gaps for a left turn from a minor road at a stop controlled intersection (Klee, 2003).

Figure 4: Full-Motion Simulator

SIMULATOR SUBSYSTEMS

Each driving simulator incorporates various subsystems that provide support to the simulation. The simulator hardware (i.e., pedals, steering wheel, etc.) supply a full array of sensory signals and stimuli to the operator which are controlled by the software (Freeman, Watson, Papelis, et al., 2000). While there are many subsystems, some of the most obvious include the visual, audio, force feedback, vehicle type, and scenario control. All of these systems work together, to create an illusion that the driver is actually in control of a real vehicle (Johansson & Nordin, 2002).

Visual System

Notably, the feedback from the visual system is a crucial factor, determining success as well as the realism of a driving simulator, impacting the driver's response to strategically react to scripted events (Xiaopeng, Hung, & Swekuang, 2000). Since visual cues are a major element in the operation of car simulators, the need for high quality graphics in the visual system is indispensable in order for the operator to experience a realistic driving experience and respond to the driving surroundings in a pragmatic way. In fact, simulating a realistic virtual environment on a visual screen depends on dynamics such as transport delay, frame rate, display size, and resolution. Some of the visual effects supplied are full field of view rearview mirrors, rain, snow, fog, and many different traffic configurations depending on the needs of the research.

Sound System

Another important attribute of a driving simulator is the sound system. While not as critical as the visual system, the ability for the driver to immerse him/herself would be incomplete in the absence of sound. Some of the main audio feedbacks include engine noise (RPM), gear shifting and various road noises.

Force feedback

The force feedback on the simulator utilized in this research project consists of a steering wheel, turn signal, and fuel, brake, and clutch pedals. The steering wheel is the most sophisticated force feedback element of the above-mentioned items. In fact, most driving simulators focus on steering realism and feedback. Steering resistance differs with speed, steering position and topography (Xiaopeng, Hung & Carolina, 2000). The steering on the simulator provides realistic feedback to the driver if the tires bump a curb or if a flat tire is triggered by a scripted event.

SCENARIO DEVELOPMENT

Validation

Validation of a simulator is gauged through the overall practicality or realism. That is, in this case how well the simulator imitates the actual driving of a tractor-trailer. According to Reymond and Kemeny (2000), the concept of simulator validation can be divided into the following categories:

- Physical Validity: Comparing the rendered motion cues in the simulator with the real-world counterparts.
- Perceptual Validity: Comparing the operator's discernment of the motion in a simulator with real-world circumstances.
- Relative Behavior Validity: Measuring the driver's response, for example, to road or traffic conditions in the simulated environment.
- Absolute Behavior Validity: Does the driver react the same way in a simulated event as he or she would in a similar real-world driving situation?

With these points in mind, when constructing scenarios for a test population, the researcher should craft all test points using the same events across all subjects. For example, if scripting a backing exercise, the developer of the scenario should allow for one slot for the truck driver to back into, thus reducing confusion as well as possible confounds. Also, for example, when the test participant is driving on a common road and a person walks in front of the car the space between the person and the car is reliant on the vehicle's rate of speed which should elicit a similar response across participants (Johansson & Nordin, 2002). In these examples the surrounding environments are controlled resulting in cleaner as well as more reliable data.

Scenario Essentials

When constructing scenarios for a test population, it is important to craft all test points using the same events across all subjects. For example, if scripting a parking exercise, the developer of the scenario should allow one slot for the driver to park in, thus reducing confusion as well as possible confounds. Also, for example, when the test participant is driving on a common road and a person walks in front of the car, the space between the person and the car determines the vehicle's rate of speed which should elicit a similar response across participants (Johansson & Nordin, 2002). In these examples, the surrounding environments are controlled, which results in cleaner as well as more reliable data.

GE Capital I-Sim's Scenario Editor Tool (Scene Edit) provides the user with the ability to create a wide range of training scenario types. To craft the scenario for this experiment required sketching out a detailed route followed by selecting an appropriate route from a library of scenario road databases. Afterwards, the appropriate vehicle types are added to the route in order to create the desired training or test scenario for the designed outcome. There are eight vehicle types to select from: Fixed Object (FO), Normal Vehicle Route (NVR), Recorded Vehicle (REC), Dynamic Control Route (DCR), Auto Density Route (ADR), Attached Trailer, Railroad Engine, and Railroad Car. The three scenarios in the study used the FO, NVR, and the ADR. A fixed object can be any stationary object, including parked cars, signs, trees, fences, shrubs and signs. A Normal Vehicle Route consists of a library that enables users to place autonomous (artificial intelligence) vehicles with a click of button. Autonomous vehicles follow a predefined route and, by default, obey the rules of the road, including obeying traffic-control devices and responding to a siren. The last vehicle type used in crafting the scenarios was the Auto Density Route. These normal vehicle routes are generated randomly to create traffic density.

Following this are the four essential features that must be present in all types of scenarios, including entering a scenario description, selecting a driving environment, placing Owncab, and placing a scenario vehicle or fixed object. The scenario description is a text description of the scenario that needs to be created. This description is given in the Description window of the editor. The selection of the driving environment depends on the requirements of the target results and experiment. The scenario editor consists of an RDB Pull down menu, which contains various types of generic environments to choose from. A few examples of the available environments include "Off-road," "Rural," "Suburban," etc. Following this was the placing of the Owncab, which is the required type of vehicle in the required location on the map using x and y co-ordinates.

The first scenario the participant is exposed to is an introduction scenario. It lasts approximately 6 to 7 minutes. It includes buildings, pedestrians, and various automobiles. This scenario is used to acclimate the participant to the simulation environment.

The test scenario takes place in a city. There are fixed signs to guide the participants through the environment. The environment includes, building, pedestrians, various automobiles, streetlights, stop signs, and other road signs that you may find in real world city environment. This scenario is used to test the experimental group. They are guided though this city by large blinking street signs that provides cues to turn.

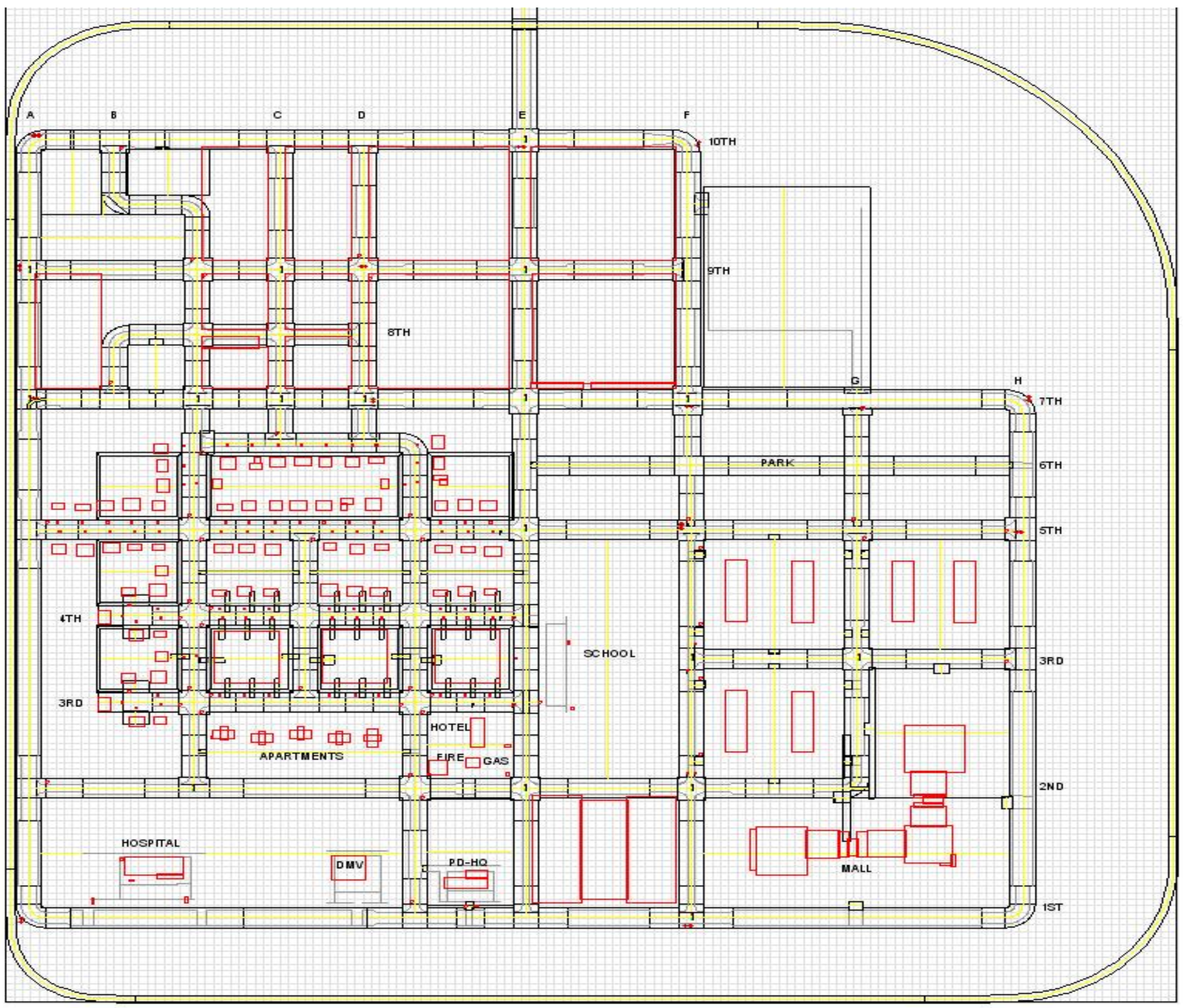

Figure 5: City Map

METHODS

Participants

Thirty participants from the University of Central Florida and the Institute for Simulation and Technology between 22 to 65 years of age participated in the experiment (15 males and 15 females**).** The lowest computer usage was 7 hours per week while the highest was 70 hours per week. Participants were recruited through word of mouth. They were placed on a list and participated as they became available for testing.

Materials and Apparatus

Paper materials covered the informed consent, demographic survey, pre-simulation sickness questionnaire, post simulation sickness questionnaire, subjective questionnaire and finally a score sheet for the grading of six critical turns throughout the test scenario. The equipment for the test was the "Patrol Simulator" built by GE Driver Development.

Patrol Simulator

"The Patrol Sim simulator (Figure 6) offers law enforcement agencies a high fidelity, interactive training experience that helps save lives. The three channel immersive driving environments combine the look and feel of a real squad car with the most advanced technology on the market

(GE Driver Development, 2003)." The Patrol Sim is proving to be a valuable training tool with limitless research possibilities.

Figure 6: Patrol Simulator

Procedure

The participants were brought into the simulation lab and were asked to fill out an Informed Consent. They were then required to fill out a demographic survey followed by a pre-screen simulation sickness questionnaire. Next, the participants were randomized in to one of three groups depending on the outcome of the toss of a coin (twice).

The three different groups that the participants were randomized into were as follows:

- Subject driving through the test scenario without using a cell phone.
- Subject driving through the same test scenario while talking on the phone.
- Subject holding the phone in his/her hand while driving through the same test scenario.

The participants were required to drive through an introduction scenario that lasted about 6 to 7 minutes before they start the actual testing scenario to get accustomed to the equipment. The test scenario itself lasted about 10 to 11 minutes.

After the subjects completed the test scenario they were asked to fill out the post-simulator sickness questionnaire and the subjective questionnaire. The subjects were tested and evaluated on 6 critical turns, three of which were right turns and the other three left turns. The three turns consisted of a turn with a signal, a turn with a stop sign and a continuous turn on each of the sides (right and left) respectively.

Right Turn 1 (Signal)

The proper execution of the right turn with a signal is as follows:

- Turn on signal
- Slow down
- Look both ways (Traffic Check)
- Use both hands
- Maintain lane while turning

Figure 7: Right Turn 1

Right Turn 2 (Stop Sign)

The proper execution of the second right turn is as follows:

- Turn on Signal
- Slow down
- Stop in front of the stop sign
- Come to a complete stop
- Look both ways(Traffic Check)
- Use both hands
- Maintain lane while making the turn

Figure 8: Right Turn 2

Right Turn 3 (Continuous)

The proper execution of the third right turn with a signal is as follows:

- Turn on signal
- Slow down
- Look both ways (Traffic Check)
- Use both hands
- Maintain lane while turning

Figure 9: Right Turn 3

Left Turn 1 (Signal)

The proper execution of the first left turn with a signal is as follows:

- Turn on signal
- Slow down
- Look both ways (Traffic Check)
- Use both hands
- Maintain lane while turning

Figure 10: Left Turn 1

Left Turn 2 (Stop Sign)

The proper execution of the second left turn is as follows:

- Turn on Signal
- Slow down
- Stop in front of the Stop sign
- Come to a complete Stop
- Look both ways(Traffic Check)
- Use both hands
- Maintain lane while making the turn

Figure 11: Left Turn 2

Left Turn 3 (Continuous)

The proper execution of the third left turn with a signal is as follows:

- Turn on signal
- Slow down
- Look both ways (Traffic Check)
- Use both hands
- Maintain lane while turning

Figure 12: Left Turn 3

The scoring schemes for participants on each of these six critical turns were as follows:

Table 1: Turn Grading

Signal Turn (Right/Left)	
Turn on signal	4 pts
Slow down	4 pts
Look both ways	4pts
Use both hands	4 pts
Stop Sign Turn (Right/Left)	
Turn on Signal	4 pts
Slow down	4 pts
Stop in front of the stop sign	2 pts
Come to a complete stop	2 pts
Look both ways	4 pts
Use both hands	4 pts
Continuous Turn (Right/Left)	
Turn on signal	4 pts
Slow down	4 pts
Look both ways	4pts
Use both hands	4 pts

After the training session all participants were required to fill out a post simulation sickness questionnaire followed by a subjective survey.

RESULTS

The quantitative results of the study verified that the use of cellular phones would adversely affects a driver's ability to perform turns, and showed that gender plays a role in the effect. However, it did confirm that gender does not play any role in a person's ability to drive.

Three groups of ten participants (5 men and 5 women each) were tested, the groups being (i) No Phone, (ii) Phone No Conversation (iii) Phone with Conversation

Table 2: Cell phone and Gender Conditions

Between-Subjects Factors

		Value Label	N
Cell Phone Condition	1	No Cellphone	10
	2	Cell No Talk	10
	3	Cell Talk	10
Gender	1	Female	15
	2	Male	15

A 2 (Gender) x 3 (Cell phone condition) between subjects design was used to assess the differences in mean driving performance between gender (male and female) at 3 cell phone conditions (No Phone, Phone No Conversation, Phone with Conversation).

Table 3: Category, Gender and Interaction Effects

Tests of Between-Subjects Effects

Dependent Variable: TOTAL

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	17.052[a]	5	3.410	17.880	.000	.788
Intercept	311.481	1	311.481	1633.010	.000	.986
CATEGORY	14.813	2	7.406	38.830	.000	.764
GENDER	.726	1	.726	3.806	.063	.137
CATEGORY * GENDER	1.513	2	.756	3.966	.032	.248
Error	4.578	24	.191			
Total	333.111	30				
Corrected Total	21.630	29				

a. R Squared = .788 (Adjusted R Squared = .744)

Results indicated a significant main effect for Cell phone Condition, $F\ (2, 24) = 38.83$, $p > .0005$, $\eta^2 = .76$ (See Table 4 for means of Cell Phone Condition).

Results also indicated a significant interaction between Gender and Cell Phone Condition, $F\ (2, 24) = 3.97$, $p = .032$, $\eta^2 = .25$ (See Table 3 for means of Cell Phone Condition with Gender) Effect for Gender was not significant [$F\ (1, 24) = 3.81$, ns].

Table 4: Cellular Phone Condition Mean Estimates

Estimates

Dependent Variable: TOTAL

Cell Phone Condition	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
No Cellphone	4.150	.138	3.865	4.435
Cell No Talk	3.067	.138	2.782	3.352
Cell Talk	2.450	.138	2.165	2.735

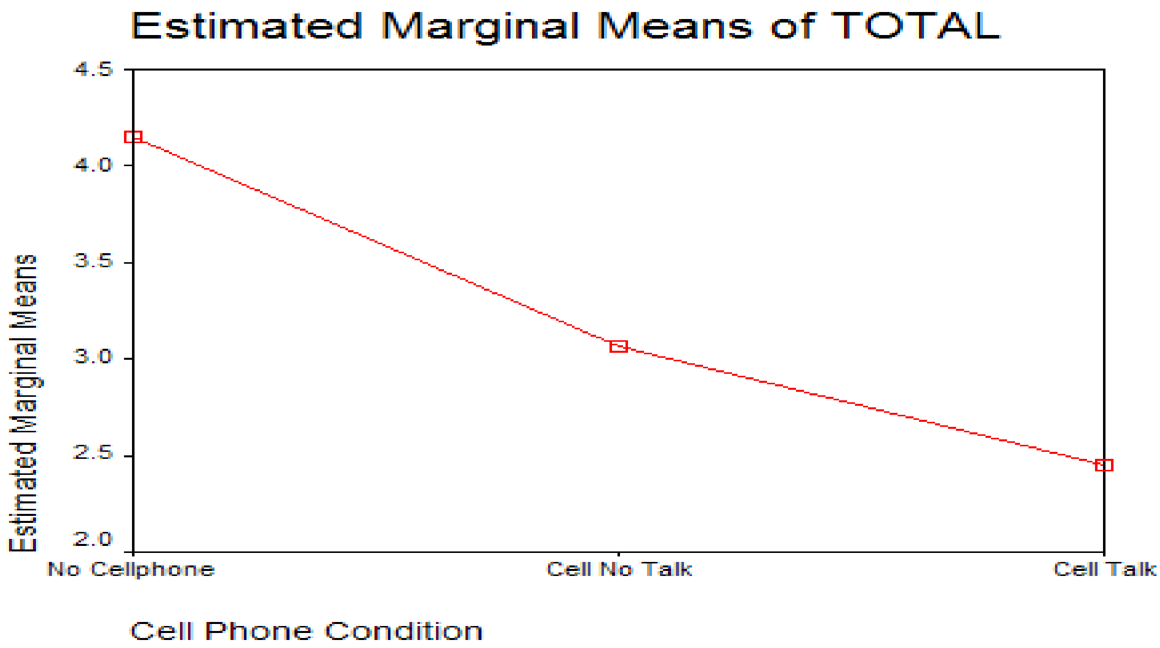

Figure 13: Graph of Cell Phone Condition

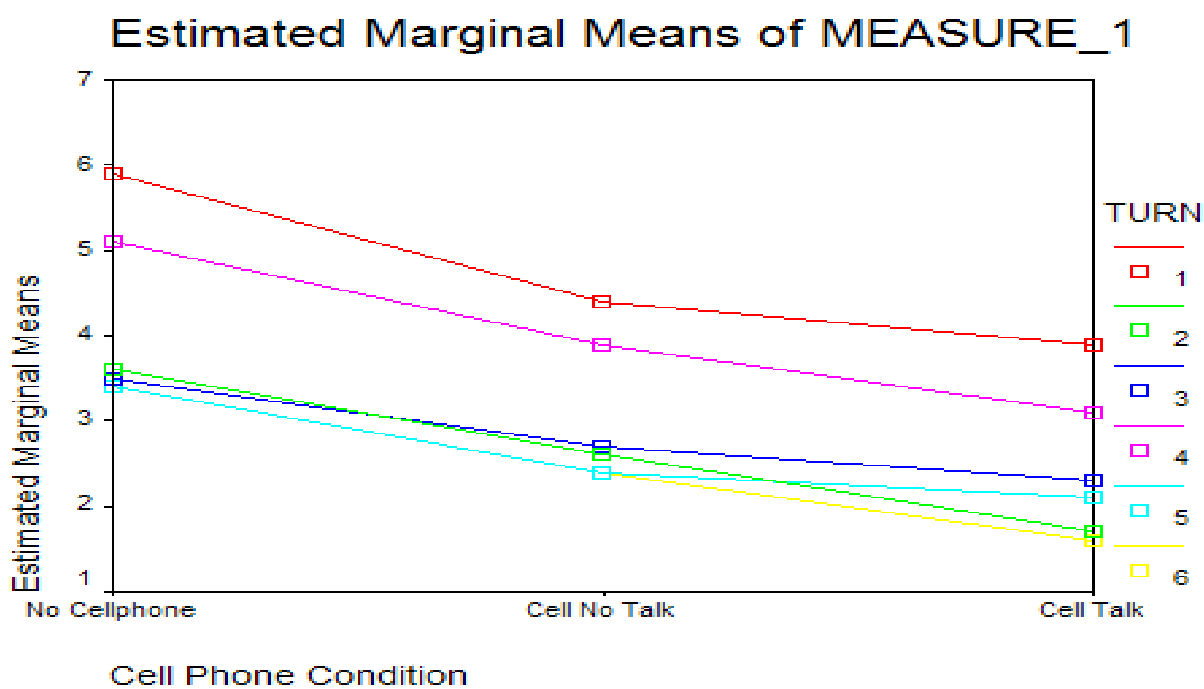

Figure 14: Graph of Cell Phone Condition per Turn

Further investigation using LSD post hoc test ($p < .05$) indicated that the scores for participants with cell phones were significantly lower than participants without cell phones. Further, participants who talked on their cell phones had significantly lower scores then participants who did not talk on their cell phones.

Table 5: Cell Phone Condition and Gender Means

3. Cell Phone Condition * Gender

Dependent Variable: TOTAL

Cell Phone Condition	Gender	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
No Cellphone	Female	4.000	.195	3.597	4.403
	Male	4.300	.195	3.897	4.703
Cell No Talk	Female	3.300	.195	2.897	3.703
	Male	2.833	.195	2.430	3.236
Cell Talk	Female	2.833	.195	2.430	3.236
	Male	2.067	.195	1.664	2.470

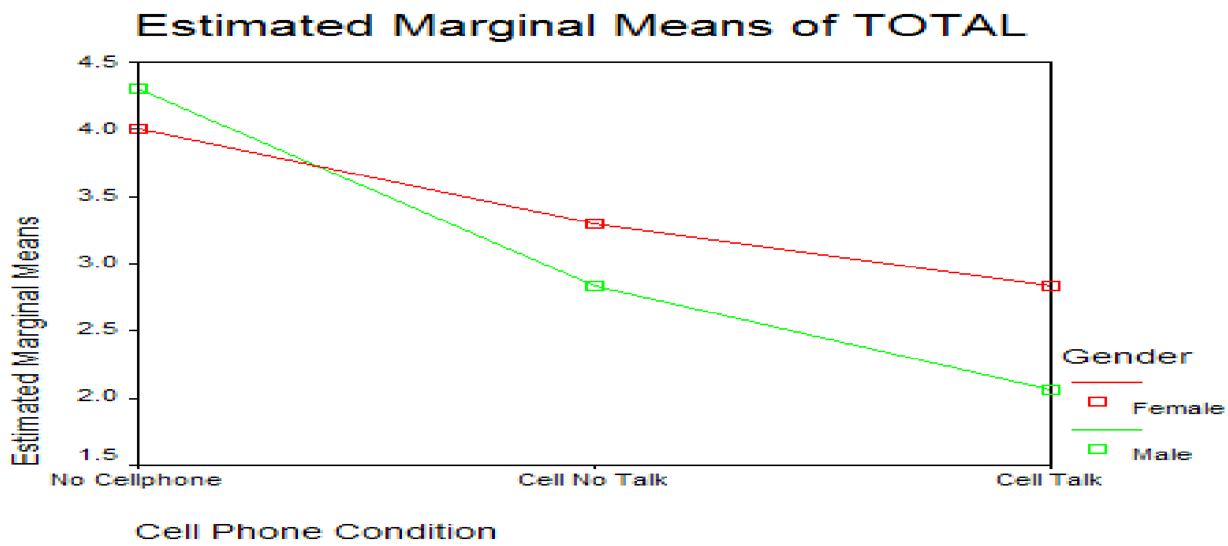

Figure 15: Graph of Cell Phone Condition per Gender

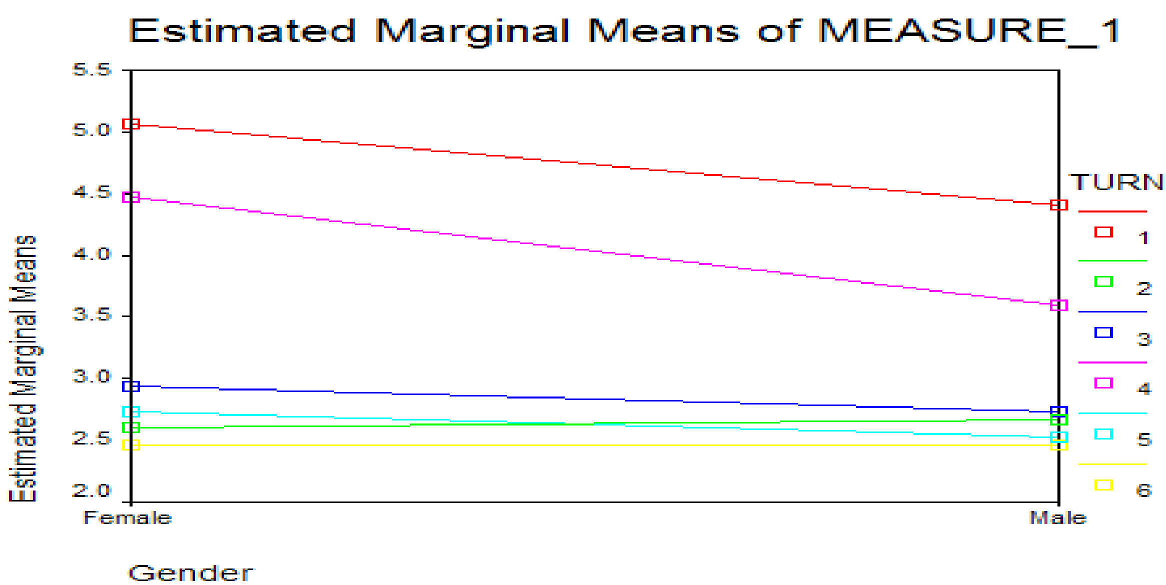

Figure 16: Graph of Gender per Turn

These results thereby validate the simulation as capable of simulating the affects of cell phones on real world drivers.

Subjective Results

The subjective questionnaires revealed the following results on the score range of 1 to 5 where 1=Strongly Disagree; 2=Somewhat Disagree; 3= Neither Agree nor Disagree; 4=Somewhat Agree; 5=Strongly Agree.

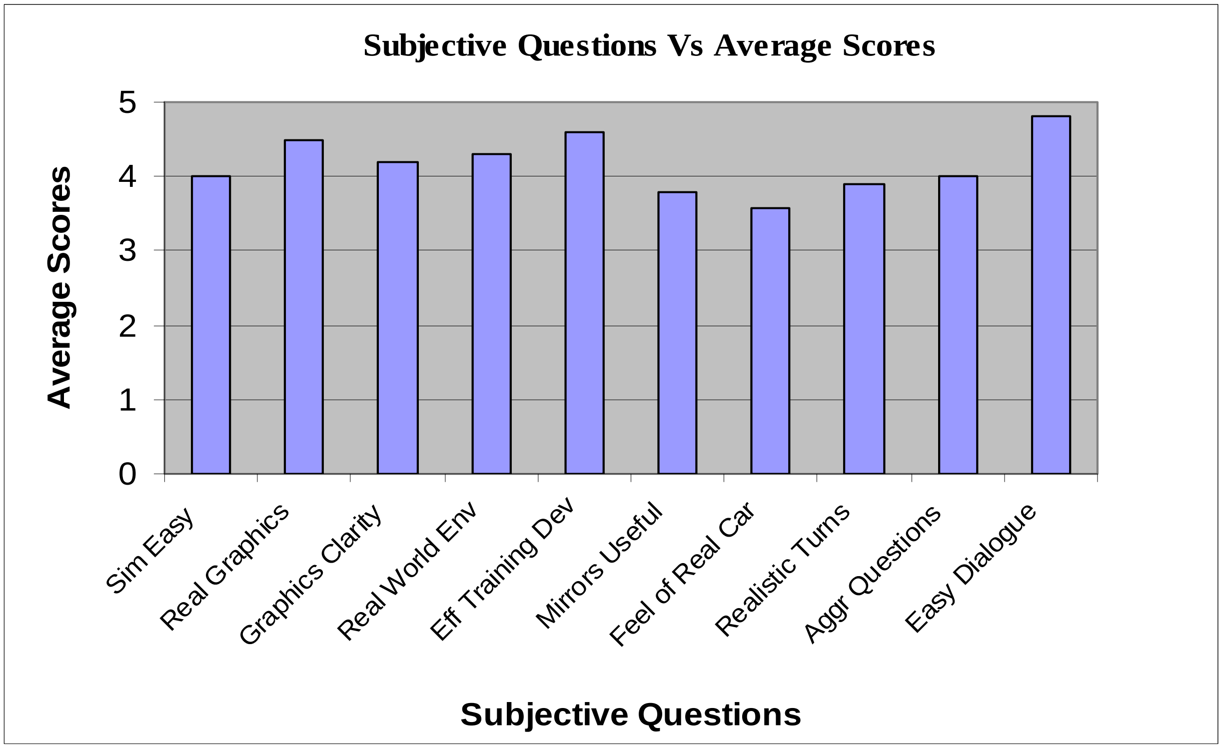

Figure 17: Subjective Questionnaire Results

Simulator Sickness

Possible symptoms of non-motion simulators include nausea, disorientation, and ocular problems, such as eyestrain, blurred vision and eye fatigue. In a fixed-based simulator, the driver remains in a fixed position while the vision system senses motion. The disparity between sensory cues may result in simulation sickness (Casali, 1986). The results from the post-simulation sickness (Figure 18) questionnaire are illustrated below.

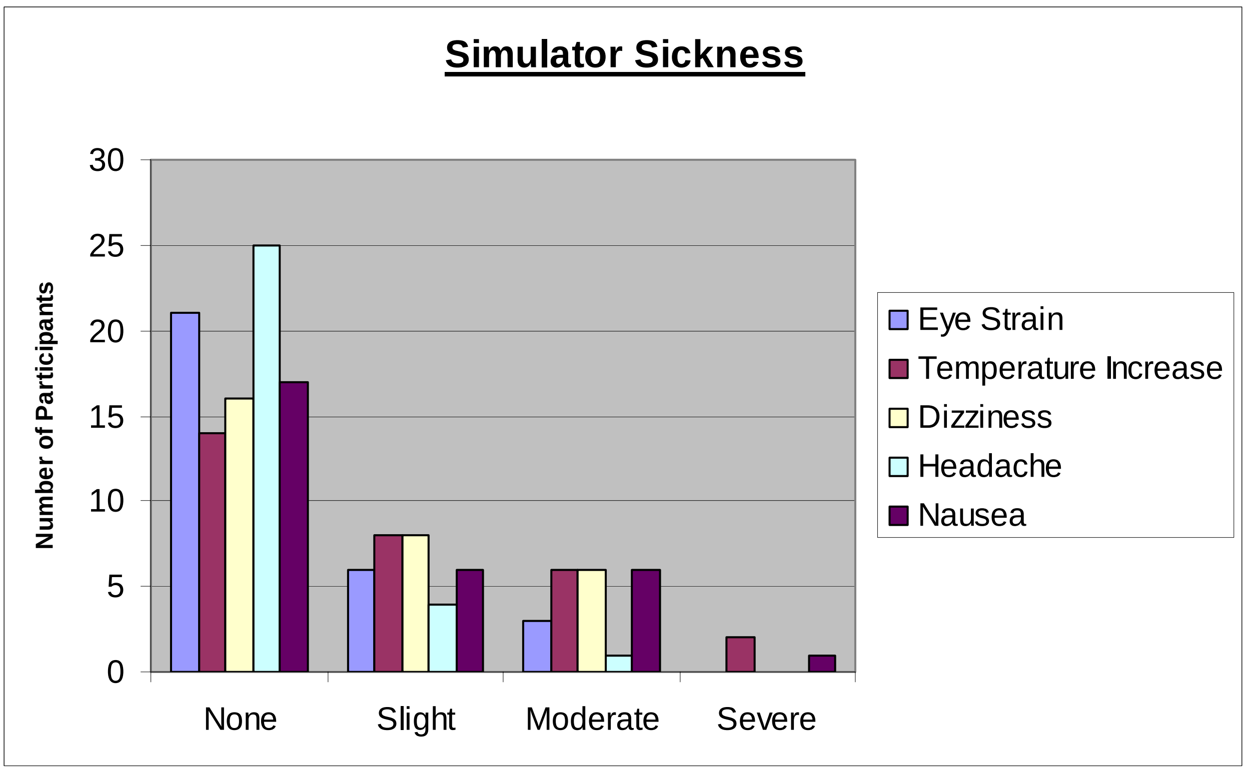

Figure 18: Simulator Sickness

DISCUSSION AND CONCLUSION

Talking on the cell phone while driving is one of the most commonly seen practices in today's world. This has resulted in a number of accidents being caused owing to the distraction caused by cellular phones. A number of literature reviews have been effective in bringing out the significant deterioration in driving skills when one is having a conversation while driving. The study was conducted on a single scenario with three different situations to find the extent of adverse effect caused in each. The three cases, driving without a cell phone, driving with a cell phone but without conversation and driving with a conversation on a cell phone, brought out significant effects on the driver's ability to execute proper turns.

The results of performance of the set of participants who drove on the test scenario without the cell phone was noted to be the highest, i.e. participants seem to be at their best when they were allowed to drive without a cellular phone. Participants who drove holding a cellular phone in hand but without being engaged in a conversation scored lower than the former but however were significantly better off in comparison to those who drove while talking on the cellular phone. The statistical comparisons showed that gender did play a role in the way one performed a turn while driving through the test scenario based on a cell phone constraint. However, there was no gender based difference in a persons overall ability to drive.

Another interesting fact that came out of the study was that women seem to have done better than men when driving while talking on a cell phone. However, it was expected that women would be more emotionally involved in a conversation and hence would do worse if they spoke on a cell phone while driving.

The results of this study gives a clear indication that talking on a cell phone while driving is extremely unfavorable and hence should be avoided to the maximum extent possible.

APPENDIX A

INFORMED CONSENT

Informed Consent

Please read this consent document carefully before you decide to participate in this study.

Project title: "Cellular Distraction: Analysis of Motor Response in a Simulated Driving Environment"

Purpose of the research study: The purpose of this study is to examine the effect of using a cell phone while driving using the Driving Simulator Environment.

What you will be asked to do in the study: One would be asked to drive the Driving Simulator and get accustomed to the equipment for a few minutes following which they would have to take up the test scenario. Here, one has to drive the Driving Simulator on the pre-designed track and go through the scenario which might last for about 15 minutes. Based on the comparison group to which a participant is randomly assigned to, he/she would be asked to talk on the cell phone while driving the simulator. Finally, fill out a questionnaire.

Time required: One up to ½ hour

Risks: A small percentage of people experience simulation sickness, in one study 1.75 % of the participants experienced nausea, 11% experienced oculomotor difficulty (eyestrain, difficulty focusing and blurred vision) and 8.7% suffered disorientation (vertigo and dizziness).

Benefits / Compensation: There is no compensation or other direct benefit to you for participation.

Confidentiality: Your identity will be kept confidential to the extent provided by law. Your information will be assigned a code number. The list connecting your name to this number will be kept in a locked file in my faculty supervisor's office. When the study is completed and the data have been analyzed, the list will be destroyed. Your name will not be used in any report.

Voluntary participation: Your participation in this study is voluntary. There is no penalty for not participating.

Right to withdraw from the study: You have the right to withdraw from the study at any time without consequence.

Whom to contact if you have questions about the study:
Anusha Ravishankar 407 882 1375, Peter Kincaid 407 882 1330

Whom to contact about your rights in the study: UCFIRB Office, University of Central Florida Office of Research, Orlando Tech Center, 12443 Research Parkway, Suite 207, Orlando, FL 32826. The phone number is (407) 823-2901.

____ I have read the procedure described above.
Participant Date I voluntarily agree to participate in the procedure.

APPENDIX B

DEMOGRAPHIC SURVEY

W CP W/O CP

Demographic Survey

1) Male____ Female____

2) Age ____

3) Have you operated a driving simulator or any other type of simulator before?

   Yes____ No____ If yes, please describe___________________________

4) Have you ever used a Desktop driving simulator? Yes____ No________

5) Do you play video games? Yes____ No________

6) At what age did you start playing video games? ____________________

7) If you use a computer, how many hours per week? __________________

8) If Yes, how often? For example, one hour a month or a week? __________

9) Have you had any major accidents? Yes____ No____

   If yes, please describe___________________________

10) Have you had any minor accidents? Yes____ No____ If yes, please describe___________________________

11) Do you have 20/20 eyesight? Yes____ No____

12) If not, is it correctable to 20\20? _______

13) Do you have a valid driver's license? Yes____ No____

APPENDIX C

SIMULATOR SICKNESS PRE-SCREENING QUESTIONNAIRE

SIMULATOR SICKNESS PRE-SCREENING QUESTIONNAIRE

This study will require you to drive in a simulator. In the past, some participants have felt uneasy after participating studies using the simulator. To help identify people who might be prone to this feeling, we would like to ask the following questions.

- Do you or have you had a history of migraine headaches? ☐ yes ☐ no

  If yes, please describe: ____

- Do you or have you had a history of claustrophobia? ☐ yes ☐ no

  If yes, please describe: ____

- Do you or have you had a history of motion sickness? ☐ yes ☐ no

  If yes, please describe: ____

- If you are a female, are you or is there a possibility that you might be pregnant?

  ☐ yes ☐ no

APPENDIX D

POST-EXPERIMENT SIMULATOR INTRODUCED DISCOMFORT QUESTIONNAIRE

Post-Experiment Simulator Induced Discomfort Questionnaire

There is a small risk associated with driving in the simulator environment. The driver may experience feelings of dizziness and increased body temperature, which are symptoms of a temporary condition called 'Simulator Induced Discomfort' (SID).
To verify the extent of SID occurrence, we are tracking the severity of any discomfort felt by those who drive in the driving environment simulator.
Sex:

❑ Male
❑ Female

Age: ______
Are you wearing prescription glasses or contact lenses?

❑ Yes
❑ Glasses
❑ Contact lenses
❑ No

What is your exposure to the driving environment simulator?

❑ First time
❑ Second time
❑ More than two times

During this most recent experience in the driving environment simulator, did you experience any feelings of discomfort?

Eye Strain:	None	slight	moderate	severe
Temperature Increase:	none	slight	moderate	severe
Dizziness:	none	slight	moderate	severe
Headache:	none	slight	moderate	severe
Nausea:	none	slight	moderate	severe

APPENDIX E

SUBJECTIVE QUESTIONS

SUBJECTIVE SURVEY

Please indicate your satisfaction or dissatisfaction regarding each of the following ten items, with 1 as Strongly Disagree and 5 as Strongly Agree.

Serial No.	Question	Strongly Disagree (1)	Somewhat Disagree (2)	Neither Agree nor Disagree (3)	Somewhat Agree (4)	Strongly Agree (5)
1	The simulator was easy to drive while completing tasks					
2	The simulator graphics were realistic.					
3	The simulator graphics were clear and easy to read.					
4	The simulator conveyed a "real word" environment.					
5	I would recommend this simulator as an effective training device.					
6	The mirrors were useful?					
7	I felt as if I was driving a real car?					
8	I felt that the turns were similar to that of driving a real car?					
9	The questions were aggravating.					
10	The dialogue questions were easy.					

APPENDIX F

SCORE SHEETS

SCORE SHEETS

SIGNAL TURN (RIGHT)	POSSIBLE POINTS
Maintained Lane (4)	Yes____ No____
Turn on signals (4)	Yes____ No____
Slow Down (4)	Yes____ No____
Looked Both Ways (Traffic Check) (4)	Yes____ No____
Used Both Hands (4)	Yes____ No____

CONTINUOUS TURN (RIGHT)	POSSIBLE POINTS
Maintained Lane (4)	Yes____ No____
Turn on signals (4)	Yes____ No____
Slow Down (4)	Yes____ No____
Looked Both Ways (Traffic Check) (4)	Yes____ No____
Used Both Hands (4)	Yes____ No____

STOP SIGN TURN (RIGHT)	POSSIBLE POINTS
Maintained Lane (2)	Yes____ No____
Turn on signals (4)	Yes____ No____
Slow Down (2)	Yes____ No____
Stop in Front of the stop sign (2)	Yes____ No____
Complete Stop (2)	Yes____ No____
Looked Both Ways (Traffic Check) (4)	Yes____ No____
Used Both Hands (4)	Yes____ No____

SIGNAL TURN (LEFT)	POSSIBLE POINTS
Maintained Lane (4)	Yes____ No____
Turn on signals (4)	Yes____ No____
Slow Down (4)	Yes____ No____
Looked Both Ways (Traffic Check) (4)	Yes____ No____
Used Both Hands (4)	Yes____ No____

CONTINUOUS TURN (LEFT)	POSSIBLE POINTS
Maintained Lane (4)	Yes____ No____
Turn on signals (4)	Yes____ No____
Slow Down (4)	Yes____ No____
Looked Both Ways (Traffic Check) (4)	Yes____ No____
Used Both Hands (4)	Yes____ No____

STOP SIGN TURN (LEFT)	POSSIBLE POINTS
Maintained Lane (2)	Yes____ No____
Turn on signals (4)	Yes____ No____
Slow Down (2)	Yes____ No____
Stop in Front of the stop sign (2)	Yes____ No____
Complete Stop (2)	Yes____ No____
Looked Both Ways (Traffic Check) (4)	Yes____ No____
Used Both Hands (4)	Yes____ No____

APPENDIX G

IRB APPROVAL LETTER

IRB APPROVAL LETTER

University of Central Florida

Office of Research

January 22, 2004

Anusha Ravishankar
3680 B. Khayyam Avenue
Orlando, FL 32826

Dear Anusha Ravishankar:

With reference to your protocol entitled, "Cell Phone User's Response to Road Signs in a Simulated Driving Environment," I am enclosing for your records the approved, executed document of the UCFIRB Form you had submitted to our office.

Please be advised that this approval is given for one year. Should there be any addendums or administrative changes to the already approved protocol, they must also be submitted to the Board. Changes should not be initiated until written IRB approval is received. Adverse events should be reported to the IRB as they occur. Further, should there be a need to extend this protocol, a renewal form must be submitted for approval at least one month prior to the anniversary date of the most recent approval and is the responsibility of the investigator (UCF).

Should you have any questions, please do not hesitate to call me at 823-2901.

Please accept our best wishes for the success of your endeavors.

Cordially,

Chris Grayson
Institutional Review Board (IRB)

Copies: Peter Kincaid
IRB File

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